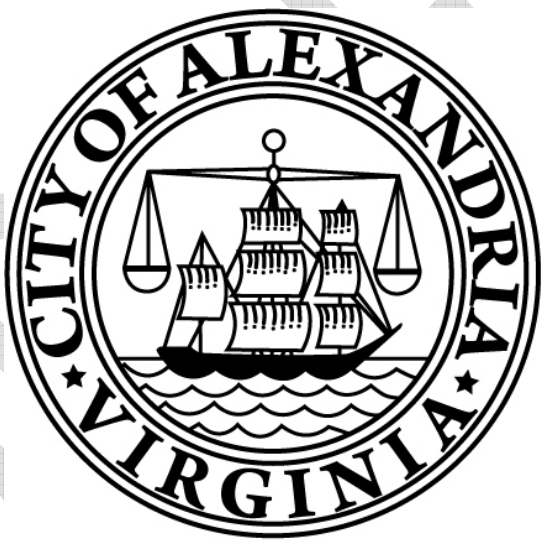
King Street, Quaker Lane and Braddock Road Traffic Study



Transportation and Environmental Services Department

August 17, 2011
Revised October 27, 2011

Table of Contents

List of Tables

List of Figures

BACKGROUND

This technical memorandum provides the findings and recommendations for the King Street, Quaker Lane, and Braddock Road intersection, and the King Street Service Road and the transit improvements in the vicinity of the intersection. The analysis was performed in March and April of 2011.

Previous Work

The City has been attempting to address the geometric layout and operation issues at the King Street, Quaker Lane and Braddock Road intersection for over 30 years. Several preliminary designs showing separated grade configurations were developed in the 1980's and 1990's to improve operations. Due to right-of-way and cost constraints these conceptual plans never evolved past the conceptual stage. This intersection is formed by three regular sized intersections operating as one complex intersection.

The City has also attempted to address issues on the service road running along the south side of the King Street intersection with the Bradlee Shopping Center/Taylor Street. The close proximity of the service road to King Street creates operational problems with the traffic signal.

In April 2010 Vanasse Hangen Brustlin, Inc. (VHB) completed the Route 7 Spot Improvement Study (http://alexandriava.gov/uploadedFiles/tes/info/BKQReportApril2010.pdf) for the City of Alexandria. The focus of the study was the development of enhancements to improve operations and safety at the intersection of King St, Quaker Lane and Braddock Road as well as nearby intersections and roadways. This study evaluated several options including grade separation, roundabout/traffic circle, minor geometric improvements and the addition of dual left turn lanes at critical turns. The study also included looking at options for the King Street service road and Quaker Lane. Ultimately, the study recommended installing dual left turn lanes at critical turns, eliminating service road access to Quaker Lane and installing a transit center on the service road in front of the shopping center to eliminate through traffic on the service road.

Why Change

After the study was completed the Safeway grocery store adjacent to the intersection announced plans to redevelop their site to include a larger store. This redevelopment offered the opportunity to reevaluate the recommendations of the VHB study to see if refinements could be made to incorporate the needs of the Safeway redevelopment. Additionally, several of the abutting businesses expressed concern over some of the measures recommended by the study. Further analysis was performed by staff incorporating the needs of the abutting commercial interests.

EXISTING CONDITIONS

Documentation on the existing conditions of the affected roadways was compiled and analyzed to determine opportunities for improvement.

Volumes and Level of Service

As shown in figure 1, several of the intersections are operating at Levels of Service (LOS) E, which is considered to be inadequate. The LOS was calculated using the VISSIM model. Growth in regional traffic and additional development within the study area are expected to generate additional traffic which will result in the deterioration of traffic conditions within the study area.

Accident Data

Collision data from the police accident database was collected. The information contained in the police accident database only represents accidents that were reported to the police. As with all intersections, many accidents go unreported if the police are never dispatched or the dollar value of the damage is too low to be considered significant. No pedestrian accidents were listed in the database for this area. The accident data for one representative year is presented in figures 2 and 3. Detailed accident data is provided in Appendix B.

Figure 1

King_Quaker_Braddock

Existing PM Period LOS and Traffic Volumes ((VISSIM))

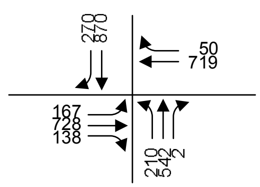
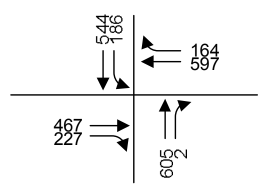
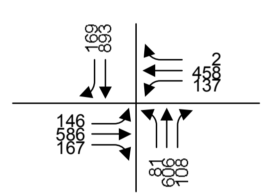
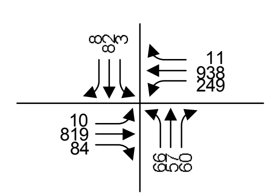
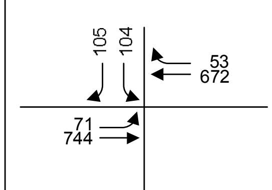
① King & Quaker	② King & Braddock	③ Braddock & Quaker	④ King & Taylor	⑤ Braddock & Marlee Way
				
Level of Service: F / 145.8	Level of Service: D / 44.1	Level of Service: D / 42.4	Level of Service: D / 39.8	Level of Service: A / 5.0

Figure 2

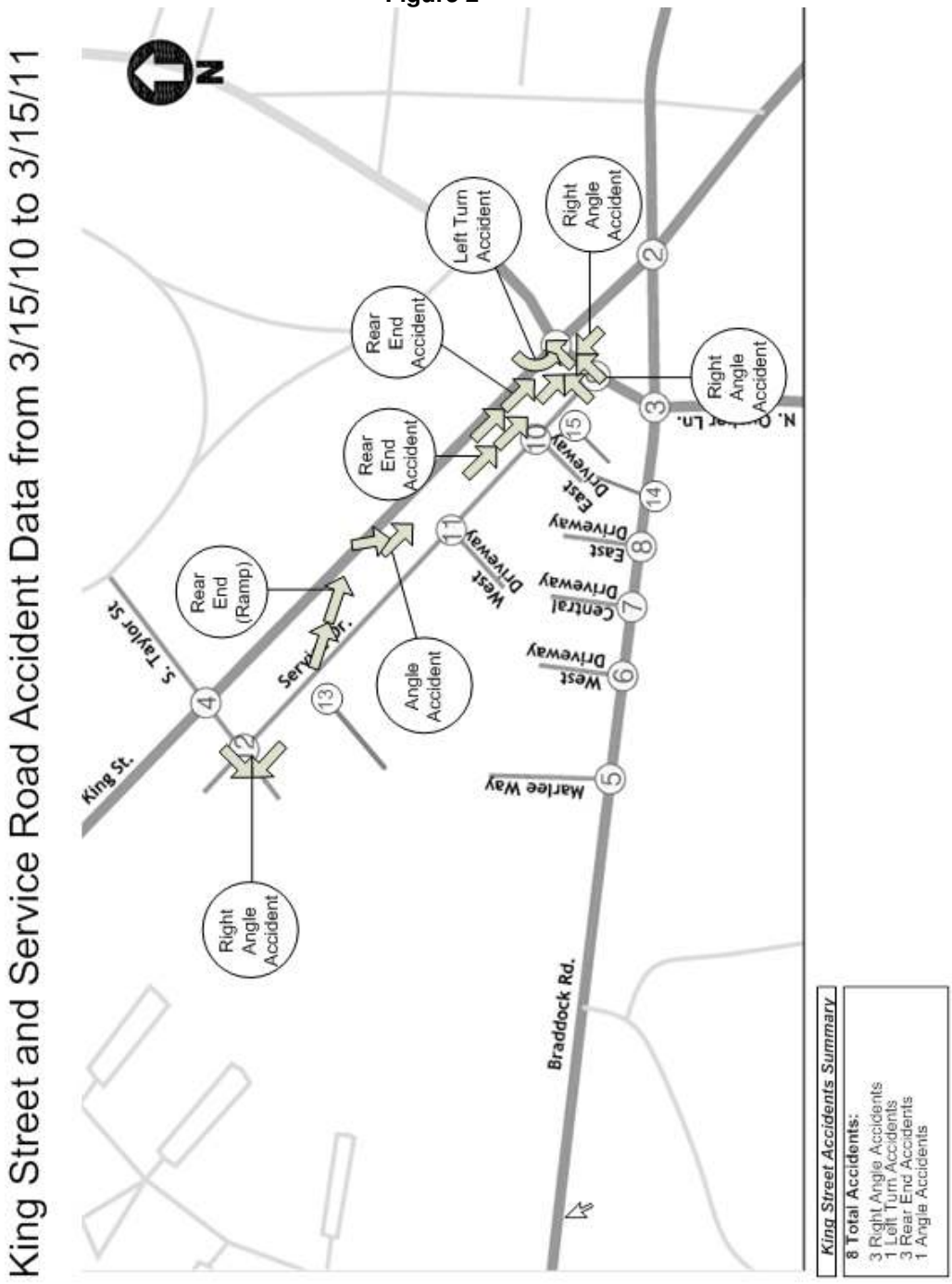
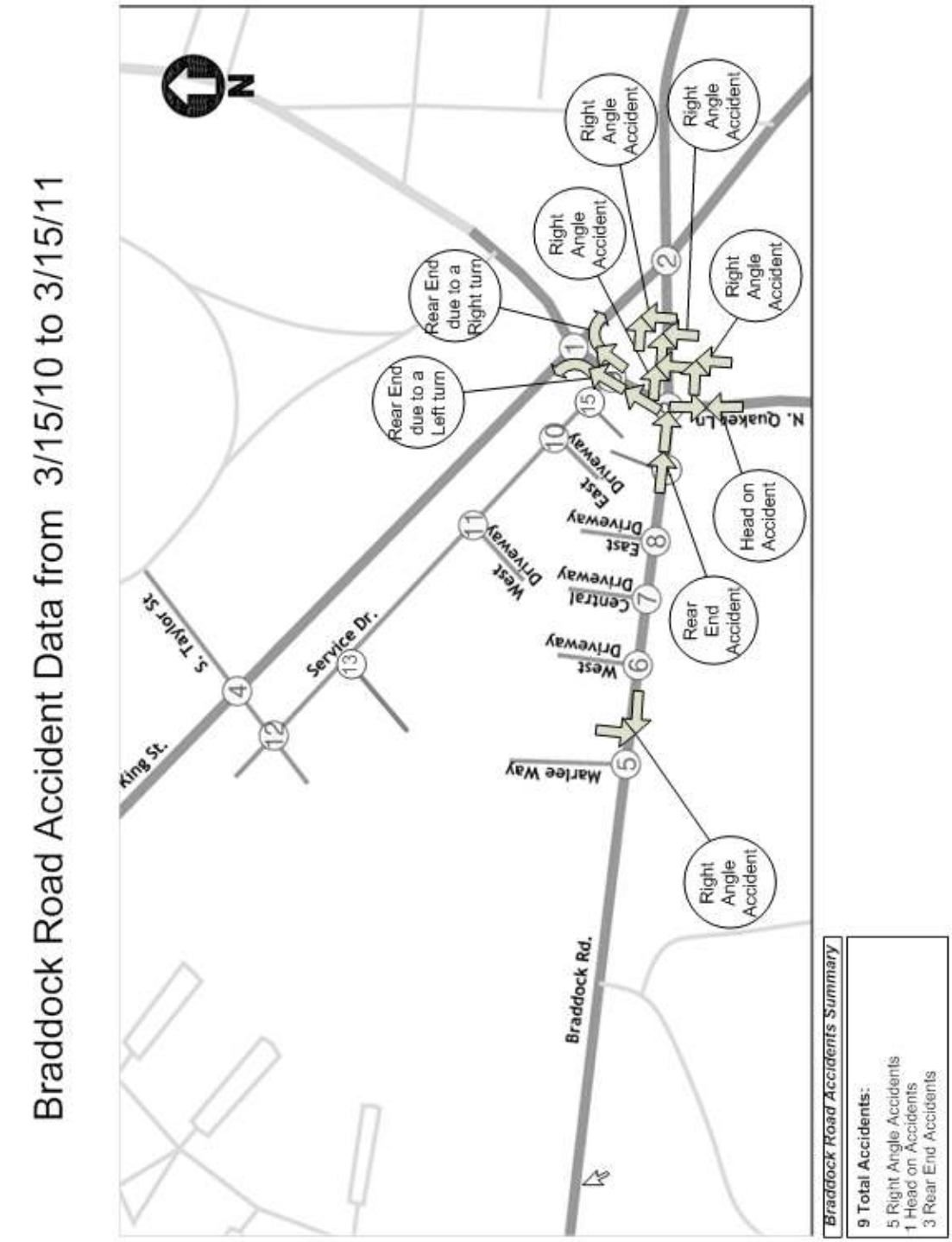


Figure 3



Pedestrian Volumes/Activity

Weekday pedestrian counts were taken at the intersection of King Street and Taylor Street on September

22, 2009 and Saturday counts were taken on August 8, 2009. These counts were taken as part of an earlier study but were recent enough to still be considered valid for this analysis. The counts showed the following:

- In eight hours on a typical weekday there are a total of 213 pedestrians crossing the intersection of King Street and Taylor Street (27 pedestrians per hour).
- In four hours on a typical Saturday there are a total of 96 pedestrians crossing through the intersection between 12 p.m. to 4 p.m. (24 pedestrians per hour).
- The highest pedestrian activity was observed crossing King Street on the east leg of the intersection for both weekdays and Saturday

The above survey data demonstrates that there is considerable pedestrian activity at this intersection. This is confirmed by the fact that the City usually receives several pedestrian complaints per year regarding the unsafe and unfriendly pedestrian conditions at this intersection. Some of these complaints are generated by the residents of Fairlington wishing to access the shopping facilities on the south side of the roadway. Many of the complaints are generated by the pedestrians crossing this intersection who are using transit.

Transit Ridership

Transit ridership data was collected for the bus stop on the service road in front of the Bradlee Shopping Center. This data provides valuable information on the extent of the transit improvements needed at this location. The data is presented in Table 1.

Table 1
Daily Average Transit Ridership

Day of Week	Boarding 2009/2020	Alighting 2009/2020
Weekday EB & WB	243/311	209/281
Saturday EB & WB	149/182	150/187
Sunday EB & WB	85/119	97/131

Daily DASH Ridership

	Boarding 2009/2020	Alighting 2009/2020
Weekday Eastbound	80/93	60/73
Weekday Westbound	116/132	118/146
Saturday Eastbound	76/81	41/54
Saturday Westbound	45/52	71/83
Sunday Eastbound	37/51	26/35
Sunday Westbound	28/35	47/61

Daily WMATA Ridership

	Boarding 2009/2020	Alighting 2009/2020
Weekday Eastbound	16/29	14/31
Weekday Westbound	31/57	17/31
Saturday Eastbound	12/28	10/19
Saturday Westbound	16/21	28/31
Sunday Eastbound	8/14	5/8
Sunday Westbound	12/19	19/27

The above data validates the demand for improved transit facilities at this location. However, the demand data does not support the construction of a transit center unless ridership increases.

Transportation Issues

The area of study is a very complex transportation network because of the number of conflict points and driver decisions that happen in a geographically small area. Three major roadways intersect at the King, Quaker, Braddock intersection and this intersection is further complicated by the addition of a service road. The geometry of this intersection leads to much driver confusion because several turns are prohibited and must be made prior to the intersection and drivers must be in the correct lane as they enter into the intersection or they may end up on the wrong road. When VHB conducted their study in 2008 one of the major concerns listed by the participants of the public meetings was how confusing this intersection was. The VHB study investigated ways to reduce driver confusion and simplify the roadway operations of this area. One of the VHB recommendations was to eliminate service road access to Quaker Lane to reduce driver confusion. Figure 4 demonstrates how the number of conflict points can be reduced by 50 percent by prohibiting access to the service road from Quaker Lane.

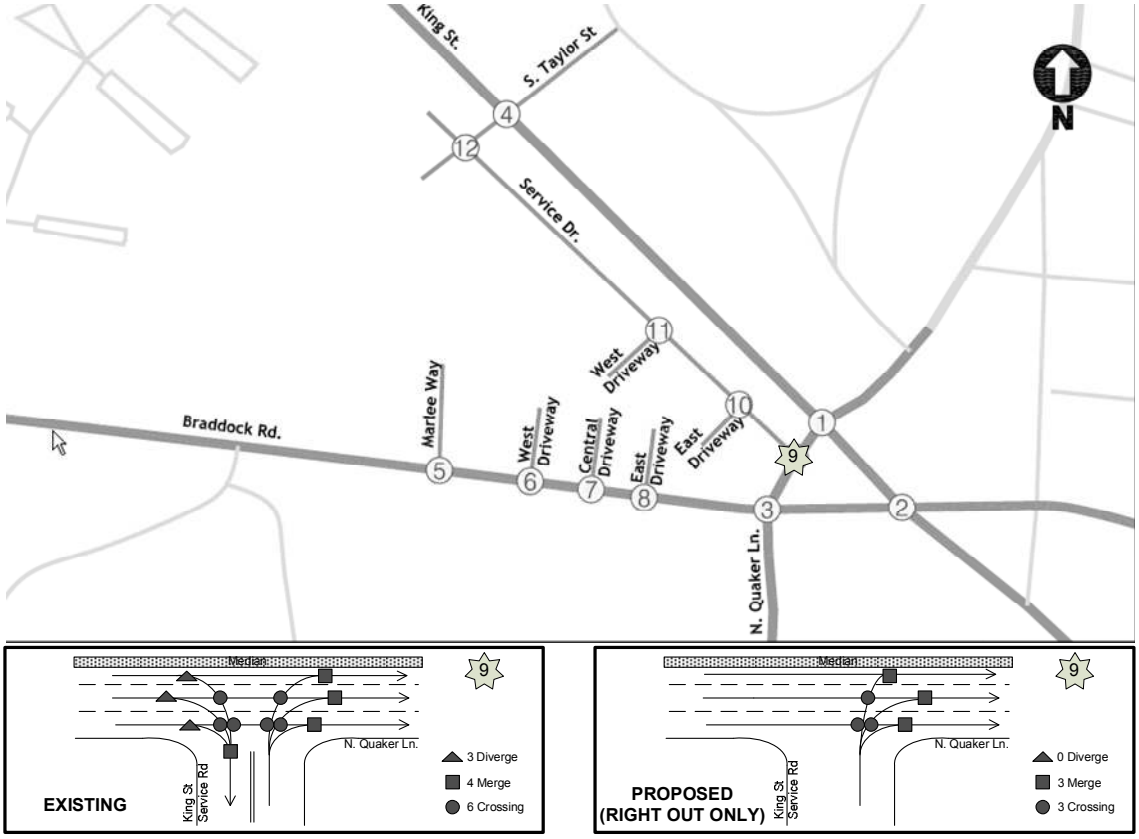
The movement of the southbound Quaker Lane traffic into the service road creates considerable friction affecting safety. The problem is that there are two right turns from southbound Quaker Lane, one on to the service road and one on to Braddock Road, in close proximity to each other. As vehicles maneuver through these turns, they slow down and disrupt traffic on southbound Quaker Lane. The right turn onto the service road is particularly problematic because the tight radius requires a slow entry into the turn.

Roadway capacity is an issue but is not the overriding issue at this location. To accommodate the limitations in roadway capacity over the years, turns have been prohibited and other alterations have been made to improve efficiency. One of the controlling factors is not the roadway capacity so much as the lack of queuing space for turning vehicles and reduced safety due to the multiplicity of conflicts within a short distance. This lack of stacking space for queued vehicles, if not managed, leads to a reduction in roadway capacity if the queue of vehicles is allowed to spill over into the through lanes. Many of the turn lanes only have enough storage capacity for a queue of two to three vehicles. Unfortunately, physical limitations preclude the possibility of lengthening many of these turn lanes. To minimize the effect of queue spillover the signal timing has had to be adjusted to lengthen green time on some of the minor movements resulting in shorter green times on some of the major movements. Consequently, it is not uncommon to see rather large queues of vehicles waiting on the major approaches to this intersection while at the same time seeing no problem on some of the minor approaches.

Pedestrian safety and accessibility at the King Street/service road and Bradlee Shopping Center driveway has been an ongoing concern. Many of the residents desiring to use the shopping center or bus service must cross King Street and the service road at this intersection. Crossing King Street is not the issue at this intersection because King Street has an exclusive pedestrian traffic signal movement. This means that when a pedestrian pushes the pedestrian button all of the vehicle signal display's show a red light, thus, eliminating most of the pedestrian/vehicle conflicts. The problem at this location is the pedestrian crossing across the service road. This is a stop sign controlled movement for the vehicular traffic. The problem with this crossing is that pedestrians not only must deal with the traffic on the service road but must also deal with traffic turning off of King Street and the shopping center. This is further compounded by the fact that there are no good pedestrian accommodations to get pedestrians safely from the service road to the shopping center.

Figure 4

King Street Service Road Conflict Points



ALTERNATIVE IMPROVEMENTS

As a way of improving pedestrian safety and accessibility the VHB study recommended closing off the service road at the shopping center exit and constructing a transit center. Closing off the service road would provide an unencumbered crossing for pedestrians as well as providing better transit accommodations. One of the justifications for the transit center, in addition to the above pedestrian issues, was that the City was considering using King Street as one of the proposed Bus Rapid Transit (BRT) routes.

Careful evaluation of the proposed Safeway expansion and the needs of the other business revealed that some alteration to the recommendations in the VHB report were in order. Staff evaluated signalizing the service road at the shopping center exit, partially closing the service road access to Quaker Lane, providing double left turn lanes at critical turns and transit improvements.

Signalized Service Road

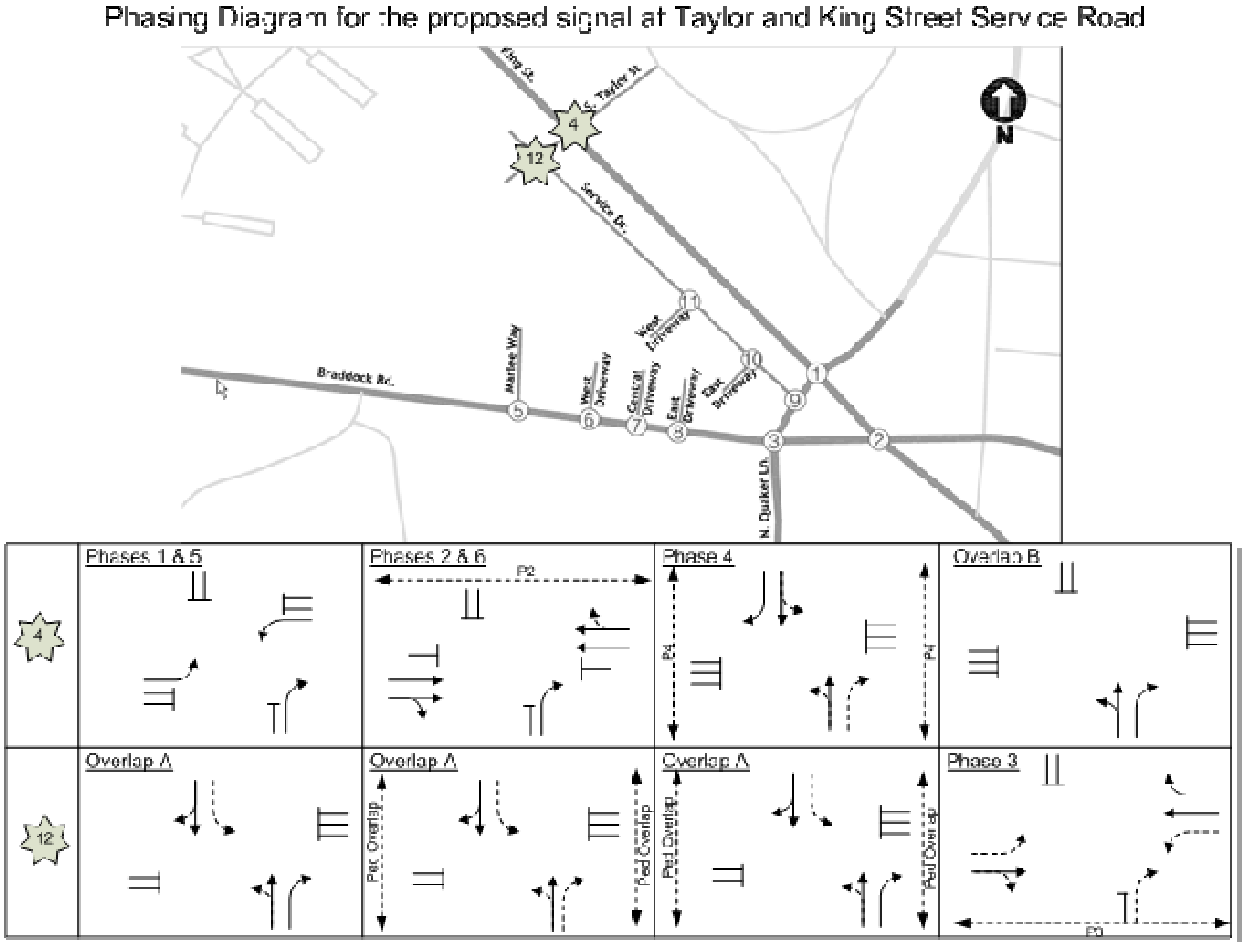
The service road intersection with the shopping center parking lot was evaluated for possible signalization. The VHB report recommended closing off the service road at this point to improve pedestrian access and to eliminate cut through traffic on the service road. A traffic signal can accomplish the goals of the proposed closure while allowing access to remain.

Under the proposed operation the eastbound King Street right turn into the shopping center would only be prohibited when the light is red. Rather than have concurrent green indications for the service road and King Street, the proposed signal operation separates these two movements, thus, not requiring an outright prohibition on right turns. The proposed operation is depicted in Figure 5.

Partial Closure of Service Road at Quaker

Staff reevaluated the service road intersection with Quaker Lane. The VHB study recommended closing access completely between the service road and Quaker Lane. This recommendation was made to help reduce the confusion and complexity of the larger intersection and reducing the number of conflict points and as well as improve the overall operation. As mentioned earlier, the right turn into the service road from southbound Quaker Lane creates considerable friction because of both the tight radius and the proximity to Braddock Road. The tight radius requires cars to slow down considerably when negotiating this turn. As a result, cars turning onto Braddock Road many times stay in the through lane longer to avoid being hindered by traffic turning into the service road. This results in increased friction for the through traffic on Quaker Lane. The problem with traffic exiting the service road is that there is very little storage space on Quaker Lane for this traffic. What ends up happening is that traffic from the service road completely fills up the space on southbound Quaker Lane between King Street and Braddock Road. When this happens traffic turning right from eastbound King Street onto southbound Quaker Lane has no place to go and so must queue on King Street holding up traffic until Quaker Lane clears out. Although staff still believes that a full closure of the service road at Quaker Lane would help simplify the intersection and improve traffic flow and safety, staff concedes that a compromise allowing traffic to exit the service road provides an essential exit option for the retail uses.

Figure 5



Double Left Turns at King/Quaker/Braddock Intersection

The VHB study recommended constructing double left turn lanes for the following movements:

1. Eastbound King Street onto Quaker Ln;
2. Eastbound King Street onto W. Braddock Rd;
3. Westbound W. Braddock Road on to N. Quaker Lane
4. Northbound N. Quaker Ln onto King St.

These additional left turn lanes are required primarily to accommodate the vehicle queue storage needs for these particular movements and improve the level of service at the study area intersections. Most of these left turn lanes only have enough storage space for just a couple of vehicles and the addition of double turn lanes will help keep the queue from extending out into the through travel lanes. As mentioned earlier, the traffic signal timing has had to be implemented for less than optimal operation to keep the queues of vehicles in the left turn lanes from spilling over into the through travel lanes. Staff believes that the proposed double left turn lanes will help improve traffic operations significantly.

Transit Improvements

The VHB study recommended closing off the service road at the Bradlee Shopping Center exit and creating a transit center. At the time of the study the City was evaluating the possibility of operating the proposed Bus Rapid Transit (BRT) through this area. A transit center seemed like a big win/win at the time because such a center would provide a valuable transit facility while improving pedestrian accessibility by closing off the service road. A close evaluation of the current transit ridership data for this stop with future projections revealed that neither current ridership nor future estimated ridership are sufficient to justify such a transit center. Staff is now recommending that the service road remain open and that the transit center concept be replaced with smart bus shelters and improved pedestrian connections to the bus shelters. These smart bus shelters will be able to provide transit riders with real time next bus information improved as well as other features.

EVALUATION OF ALTERNATIVES:

Staff evaluated two alternatives including existing conditions. The alternatives are as follows:

Option 1:

- Partially close the service road intersection with Quaker Lane to allow right out from the service road only
- Introduce a traffic signal at the service road intersection with the Bradlee Shopping Center driveway.
- Provide new smart bus shelters with real time bus information and bus route map at the Bradlee Shopping Center and at Safeway and improved pedestrian connections to the bus shelters.

Option 2:

- Introduce double left turn lanes at the following approaches:
    1. Eastbound King Street onto Quaker Ln;
    2. Eastbound King Street onto W. Braddock Rd;
    3. Westbound W. Braddock Road on to N. Quaker Lane
    4. Northbound N. Quaker Ln onto King St.

- Partially close the service road intersection with Quaker Lane to allow right out from the service road only
- Introduce a traffic signal at the service road intersection with the Bradlee Shopping Center driveway.
- Provide new smart bus shelters with real time bus information and bus route map at the Bradlee Shopping Center and at Safeway and improved pedestrian connections to the bus shelters.

A VISSIM analysis of the above scenarios was performed for the PM peak hour to evaluate any potential impacts these proposals would have. The AM peak hour conditions were analyzed because the PM peak hour volumes are significantly higher due to the presence of a large retail development within the study area. VISSIM was chosen as the analysis tool rather than SYNCHRO or HCM because VISSIM accounts for the interaction between all of the intersections in a network. SYNCHRO and HCM do not account for traffic queue spillover. The results of the VISSIM analysis are shown in Table 2 and Figure 6:

Table 2
VISSIM Analysis for PM Peak Conditions

Intersection	Existing (delay in sec/LOS.)	Option 1 (delay in sec./LOS)	Option 2 (delay in sec./LOS)
King Street and N. Quaker Lane	145.8/F	148.3/F	56.9/E
King Street and W. Braddock Road	44.1/D	51.5/D	65.9/E
W. Braddock Road and N. Quaker Lane	42.4/D	48.5/D	37.5/D
King Street and Taylor Street/ Bradlee shopping center	39.8/D	44.5/D	37.1/D
Service Road and Bradlee Shopping Center	6.7/A	28.3/C	32/C

Figure 6
VISSIM Queue Lengths (PM peak)

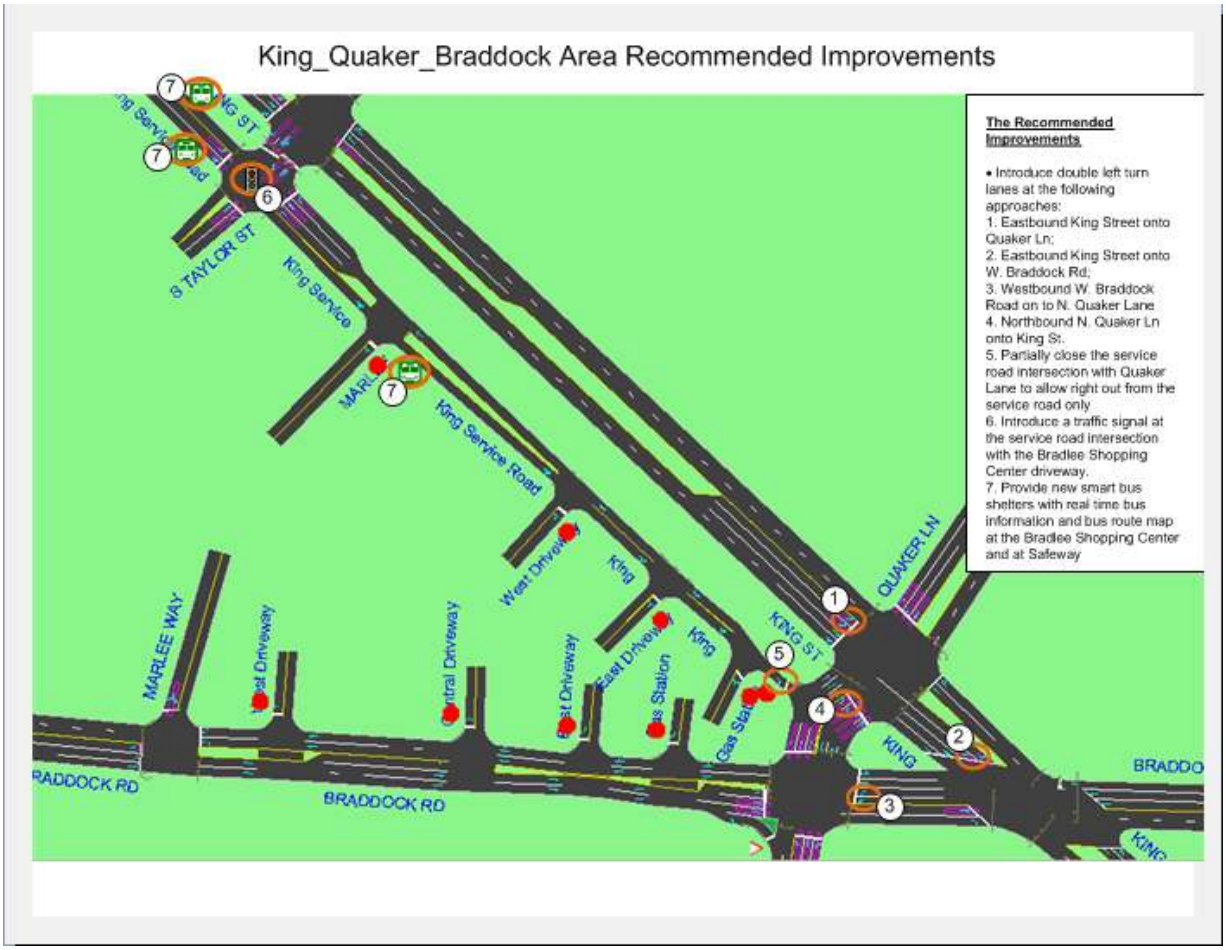
FINDINGS AND RECOMMENDATIONS

Based on staff's analysis the following is recommended:

- Introduce double left turn lanes at the following approaches:
    1. Eastbound King Street onto Quaker Ln;
    2. Eastbound King Street onto W. Braddock Rd;
    3. Westbound W. Braddock Road on to N. Quaker Lane
    4. Northbound N. Quaker Ln onto King St.

- Partially close the service road intersection with Quaker Lane to allow right out from the service road only
- Introduce a traffic signal at the service road intersection with the Bradlee Shopping Center driveway.
- Provide new smart bus shelters with real time bus information and bus route map at the Bradlee Shopping Center and at Safeway
- Provide improved pedestrian facilities between residential establishments and bus shelters

Figure 7


King_Quaker_Braddock Area Recommended Improvements
The Recommended Improvements
• Introduce double left turn lanes at the following approaches:
1. Eastbound King Street onto Quaker Ln;
2. Eastbound King Street onto W. Braddock Rd;
3. Westbound W. Braddock Road on to N. Quaker Lane
4. Northbound N. Quaker Ln onto King St.
5. Partially close the service road intersection with Quaker Lane to allow right out from the service road only
6. Introduce a traffic signal at the service road intersection with the Bradlee Shopping Center driveway.
7. Provide new smart bus shelters with real time bus information and bus route map at the Bradlee Shopping Center and at Safeway
S TAYLOR ST
King Service
King Service Road
MARLEE WAY
QUAKER LN
KING ST
BRADDOCK RD
West Driveway
East Driveway
Gas Station

Appendices

Appendix A

When analyzing delays for current conditions, staff had three sets of data to pick from. The three sources of data were:

1. Traffic counts collected in 2009-2010 by Volkert and Associates for a citywide signal retiming project.
2. Traffic counts collected in 2008 by VHB for an analysis of traffic conditions at and around the King/Quaker/Braddock intersection.
3. Traffic counts submitted by the consultant analyzing the Safeway redevelopment.

Staff analyzed the traffic volumes from these three data sources and concluded that the use of the VHB data, adjusted to reflect 2011 conditions, was the most appropriate course of action. The Volkert traffic volumes are significantly lower than the VHB counts. The lower Volkert volumes were the result of the regional diversions due to construction at the Telegraph Road interchange. As a result of the Telegraph Road construction, some drivers who normally drive on Quaker Lane to access I-495 from I-395 have diverted their travel paths to avoid the Telegraph Road construction area. The traffic volumes provided by Safeway are significantly lower than the VHB volumes.

Existing PM Volume and HCM LOS Comparisons with Other Data Sources

King & Quaker	EB	WB	NB	SB	Total	LOS
Volkert	1020	755	764	745	3284	D
VHB	1003	747	768	1107	3625	F
Safeway	1059	728	579	647	3013	D
King & Braddock						
Volkert	473	790	447	608	2318	D
VHB	707	739	590	709	2745	E
Safeway	404	627	452	518	2001	D
Braddock & Quaker						
Volkert	697	480	882	808	2867	D
VHB	906	580	772	1032	3290	D
Safeway	646	400	650	784	2480	C
King & Taylor						
Volkert	991	1205	180	83	2459	C
VHB	984	1162	100	53	2299	C
Safeway	1026	1206	180	83	2495	C
Braddock & Marlee						
Volkert	568	635		247	1450	B
VHB	824	704		203	1731	B
Safeway	547	587		230	1364	B

VHB CORSIM Level of Service for Existing Conditions

Approach	AM Peak LOS	PM Peak LOS	Saturday LOS
King Street/Quaker Lane			
EB	F	E	E
WB	B	A	B
NB	C	A	C
SB	C	F	C
Overall	D	E	C
King Street/Braddock Road			
EB	C	B	B
WB	C	C	B
SE	C	B	B
NW	D	E	C
Overall	C	C	C
Braddock Road/Quaker Lane			
EB	D	D	C
WB	C	B	D
NB	F	D	C
SB	B	C	B
Overall	E	C	C

Appendix B

King Street Accident Data from 3/15/08 – 3/15/11

King Street at	Accident Type
MARLEE WAY	Rear End
Bradlee Shopping	Left Turn
Bradlee Shopping	Angle
QUAKER	Rear End
3600 block	Rear End
QUAKER	Left Turn
3600 block	Angle
QUAKER	Angle
Taylor	Rear End
3500 block	Rear End
Bradlee Shopping	Angle
QUAKER	Rear End
QUAKER	Side swipe
QUAKER	Rear End
QUAKER	Rear End
QUAKER	Side swipe
QUAKER	Rear End
QUAKER	Fixed object
QUAKER	Angle
QUAKER	Rear End
QUAKER	Angle
QUAKER	Left Turn
QUAKER	Backed into
QUAKER	Head on
QUAKER	Rear End
QUAKER	Angle
QUAKER	Rear End
QUAKER	Angle
QUAKER	Angle
QUAKER	Angle
QUAKER	Angle
QUAKER	Angle
QUAKER	Side swipe
QUAKER	Rear End

Appendix B (Continued)
Braddock Road Accident Data from 3/15/08 – 3/15/11

Braddock Road at	Accident Type
QUAKER	Rear End
MARLEE WAY	Angle
QUAKER	Side swipe
QUAKER	Rear End
QUAKER	Angle
QUAKER	Angle
QUAKER	Angle
QUAKER	Angle
QUAKER	Angle
QUAKER	Angle
QUAKER	Side swipe
QUAKER	Rear End
QUAKER	Rear End
QUAKER	Angle
QUAKER	Angle
QUAKER	Head on
QUAKER	Head on
QUAKER	Angle